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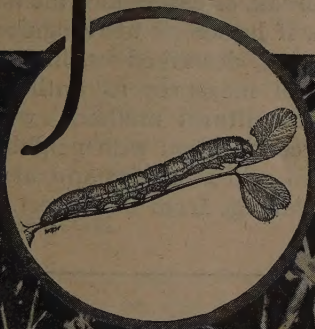
The Alfalfa Caterpillar



THE YELLOW BUTTERFLIES of the alfalfa caterpillar are found over most of the United States, but they are not always recognized as the adult stage of the "green worms" that cause so much damage in the extensive alfalfa-growing sections of the Western and Southwestern States. The larvæ, or "worms," feed on the leaves and the tender terminal buds, and in cases of severe infestation eat a portion of the stem also.

Each female butterfly lays from 200 to 500 eggs, and as the period of development in the warm Southwest is very short, immense numbers of the destructive caterpillars are found. It is estimated that they cause a financial loss approximating a million dollars a year in alfalfa fields in California and Arizona alone.

The farmer who is on the alert can prevent an outbreak, or can reduce the damage from an infestation, if he learns to recognize the various stages of the pest, described in this bulletin, and to employ control measures as outlined in pages 12 to 16. Clean cultural methods, well-regulated irrigation, and cooperation with neighbors, if consistently followed, will minimize and, at times, totally eliminate the damage from this insect.

Contribution from the Bureau of Entomology
L. O. HOWARD, Chief
Washington, D. C. April, 1920

THE ALFALFA CATERPILLAR[1]

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THE ALFALFA CATERPILLAR is one of the most destructive insect pests of alfalfa in the southwestern United States. In 1914 a complete report[2] of the life history of this caterpillar, together with the methods of control, was published. The present paper contains additional information relating to methods of controlling the pest by the management of irrigation water as well as a brief account of its natural history, and is intended to meet the ever-increasing demands of ranchers and others for assistance in protecting their alfalfa against these "green worms."

DESCRIPTION.

In order to foresee an outbreak of this pest and adopt suitable control measures, it is first necessary to be able to recognize the different stages of this insect.

There are four of these, namely, the egg; the larva, or "green worm" stage; the pupa, or resting stage; and the adult, or butterfly stage. A great many farmers fail to recognize the "green worms" in their alfalfa as the young of the thousands of yellow butterflies that were flitting over their alfalfa fields a week or 10 days before. In order that the alfalfa grower may become acquainted with

[1] *Eurymus eurytheme* Boisd.
[2] Wildermuth, V. L. The alfalfa caterpillar. U. S. Dept. Agr. Bul. 124. 1914.

and learn to recognize these different forms, the following descriptions are given:

The adult (fig. 1) of the alfalfa caterpillar is a very beautiful yellow butterfly about 2 inches wide from wing tip to wing tip. The under surface of the wings and the part visible when the butterfly is at rest are a solid light yellow color, while the upper wing surface is bordered by black. The male (fig. 2) may be distinguished from the female (fig. 1) by the fact that the outer border of the wings is solid black in the former but broken by a line of yellow splashes in the latter. White "freak," or albino, specimens are frequently noticed.

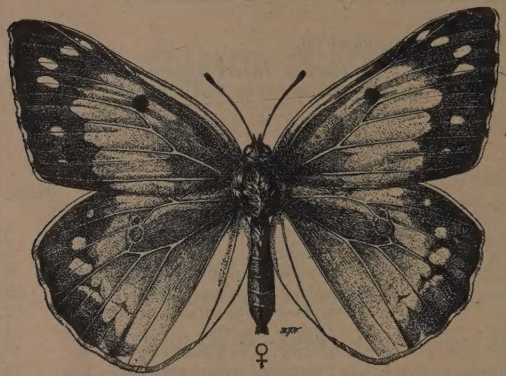

FIG. 1.—The alfalfa caterpillar: Female in adult, or butterfly, stage. One-half enlarged.

The egg (fig. 3) laid by the female is six one-hundredths of an inch long. It is elongate, white when laid, but turning reddish brown after the second day, and is deposited upright with the basal end attached usually to the upper surface of the leaf.

The larva, or "green worm," when first hatched, is a tiny, dark brown, cylindrical object which soon after feeding takes on a green color. Growth is rapid and the larva (fig. 4), after having shed its skin, or molted, four times, is a little more than an inch in length and is of a dark grass-green color, with a white stripe on each side of the body, through which runs a crimson line. There is often an intermediate, narrower, broken, and less distinct white line just above each of the lateral lines. In some specimens a black or dark green median dorsal line is also present.

FIG. 2.—The alfalfa caterpillar: Male in adult, or butterfly, stage. One-half enlarged.

The pupa (fig. 5) is yellowish green, with a conspicuous row of black dots just within the margin of each wing pad and three black dots on each side of the abdomen. It is free, having no cocoon, and is found, head up, attached closely by its posterior end to an alfalfa

stalk or other support with the anterior end hanging loosely in a threadlike swing which is joined to the same support.

DISTRIBUTION.

The yellow butterflies of the alfalfa caterpillar are found over most of the United States. In the Mississippi Valley (see map, fig. 6) and some of the Southern States these caterpillars are often abundant, but they are found in destructive numbers and doing their greatest damage to alfalfa throughout the sections of the Western and Southwestern States where irrigation is extensively developed. The irrigated valleys of Arizona and California are visited yearly by this pest.

FIG. 3.—Alfalfa caterpillar: Egg, greatly enlarged. (Redrawn from Scudder.)

ECONOMIC IMPORTANCE.

As has already been mentioned, these caterpillars are present in destructive abundance nearly every year in some portion of the Southwestern States. In the Imperial and San Joaquin Valleys of California and in the Yuma, Salt River, and Gila River Valleys of Arizona, they prevent the maturing of many tons of hay. Some years only very small sections or even individual fields may be seriously infested and an entire crop destroyed, but other years the outbreak becomes widespread and, if control measures are not used, takes the major portion of one cutting of hay over the entire area. It is safe to estimate that from 25,000 to 60,000 tons of hay are destroyed

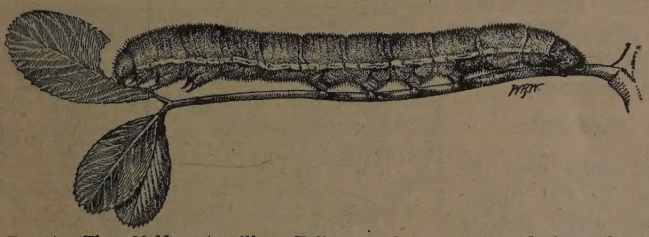

FIG. 4.—The alfalfa caterpillar: Full-grown larva. Enlarged about three diameters.

in a year in the two States of California and Arizona alone. This means a financial loss of a half million to a million dollars that year.

The energetic and up-to-date farmer can greatly reduce, and at times totally eliminate, this damage if he will only acquaint himself with the habits of the insect and the methods of control.

INJURY TO THE ALFALFA PLANT.

The injury to the alfalfa plant is caused by the larvæ feeding. The very small larvæ eat holes in the leaves, but after only a few days' growth they consume the whole leaf and the tender terminal buds.

In severe outbreaks a portion of the stem may also be eaten. The adults feed on the nectar of the blooming plants and in no wise injure the plant, leaving that to their destructive young—the larvæ, or "green worms." In cases of very heavy infestation the decayed remains of worms killed by a disease (which will be discussed later on) often impair the quality of the harvested hay, and thus cause an additional loss.

FIG. 5.—The alfalfa caterpillar: Chrysalis, or pupa.

SEASONAL HISTORY.

This insect usually passes the winter season in the pupal stage (see fig. 5), although in the Southwest both larvæ and adults have been taken during every month of the winter. These pupæ are often found on waste alfalfa along fence rows, ditch banks, or other places. (See fig. 12.) A great many of these overwintering helpless pupæ are destroyed either by their natural enemies or by climatic conditions. The rancher can assist in this destruction of pupæ by cleaning up all fence rows, ditch banks, and other waste places.

During the months of February and March, adult butterflies issue from the overwintering pupæ. The butterflies soon lay eggs from which hatch the green worms, which in turn, by the end of May, produce more butterflies. Following this there is a generation about every 30 days, so that, if left unmolested, by July or August the butterflies are present in surprising numbers. Thus, there are from three to seven generations each year, depending on location and climatic influences.

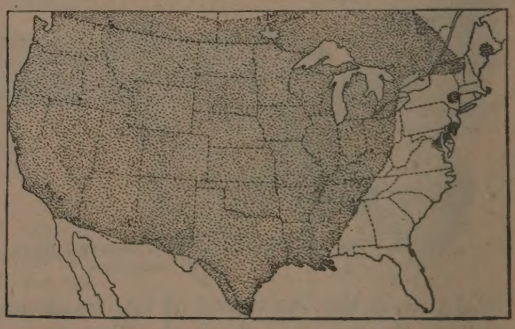

FIG. 6.—Map showing distribution of the alfalfa caterpillar.

THE EGG.

The eggs may be found on the upper surface of alfalfa leaves. There may be several on a single leaf, although they are usually laid singly. These eggs hatch in from three to seven days. The rancher should be on the lookout for the eggs and watch the development of the young hatching therefrom, so that he may be prepared to start control measures should these become necessary.

THE LARVA.

The larvæ or caterpillars grow very fast during warm weather and often become full grown within 12 to 15 days after hatching, having

increased during this time from less than one-tenth inch to nearly 1½ inches in length. The larva is often difficult to see as it stretches itself along an alfalfa stalk, the green color of its body being about the same shade as the alfalfa upon which it is feeding.

THE PUPA, OR CHRYSALIS.

The pupæ (fig. 5) are found hanging, head up, attached to alfalfa or other stems, and as their color blends with their environment they are often difficult to distinguish, and may be overlooked unless carefully sought. Often, too, instead of pupating on a bare stem the larvæ crawl to a leafy stem and pupate there, thus protecting themselves still further from their enemies and from the rays of the sun.

This is a resting period of about five to seven days, during which the caterpillar is transformed to a butterfly. Throughout it the pupa remains almost motionless and is suspended from its support by slender silken threads.

THE ADULT, OR BUTTERFLY, STAGE.

The adult butterfly usually emerges from the pupa early on a bright morning. It crawls up any convenient support, quite soon spreads and dries its wings, and is off looking for bloom upon which to feed. The sexes often mate the same day they issue but usually the second day, and in another day the female begins to lay her eggs. She lays from 200 to 500 eggs during her brief life of about two weeks. This large number of eggs and the short period of development in the warm Southwest account for the occurrence of immense numbers of these worms. Suppose a female issues from its winter home in March and lays 400 eggs. By the end of May, if all her eggs hatched and the young all grew to maturity, there would be 400 butterflies, of which half, or 200, would be females. These would produce 80,000 adults by the end of June, 16,000,000 by the end of July, and 3,200,000,000 by the end of August. Thus the destruction of a female pupa in February in reality obviates the possibility of the development of more than 3,000,000,000 larvæ and their attack upon the alfalfa during July and August.

The female butterflies nearly always search out young and tender growing alfalfa for their egg laying. Hence, the eggs are more often found on alfalfa when it is from 2 to 8 inches tall. It is, therefore, necessary to keep a lookout for caterpillar eggs only on alfalfa of this size.

FOOD PLANTS.

These caterpillars feed upon a variety of different plants, but alfalfa seems to be their favorite food plant and the one that is most seriously injured by them.

THE VALUE OF NATURAL ENEMIES IN REDUCING OUTBREAKS.

Were it not for the fact that this species is preyed upon by a great many natural enemies it would indeed prove a much more serious pest than it actually is at present. Parasites and predacious insects, fungous and bacterial diseases, birds, toads, and even domestic fowls, all play a large part in keeping the species within bounds.

PARASITES.

A very small parasite [1] destroys the eggs and often as many as 50 per cent of them fail to hatch because of its work. A butterfly egg thus parasitized turns black instead of the natural reddish brown.

FIG. 7.—*Phorocera claripennis*, a parasite of the alfalfa caterpillar: Adult. Enlarged.

Several kinds of parasitic flies [2] often prey upon the caterpillars or young. One of these flies is pictured in figure 7. The white eggs from this fly are deposited on the half grown worms. Their white color makes them very conspicuous spots on the green-colored worms. A tiny maggot hatches from one of these eggs and immediately works its way into the caterpillar. Here it feeds and grows gradually, eating out the interior of the green worm, which soon dies.

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[1] *Trichogramma minutum* Riley. [2] *Phorocera claripennis* Macq., etc.

Another parasite[1] which is of importance in controlling this caterpillar is shown in figure 8. It is a minute black insect that lays its eggs within the pupa or resting stage of the caterpillar. These eggs hatch into tiny grubs (fig. 9) which eat out the interior of the pupa. Later the adult insects gnaw holes in the empty pupal shell and crawl out, as is shown in figure 10. Some years 60 per cent of the pupæ are destroyed in this way.

The bollworm[2] (fig. 11), which is ordinarily an injurious worm on corn and cotton, feeds upon both the caterpillars and pupæ of this butterfly.

A CATERPILLAR DISEASE.

The most important enemy of this caterpillar, however, is a disease, probably of bacterial origin, which is quite common upon

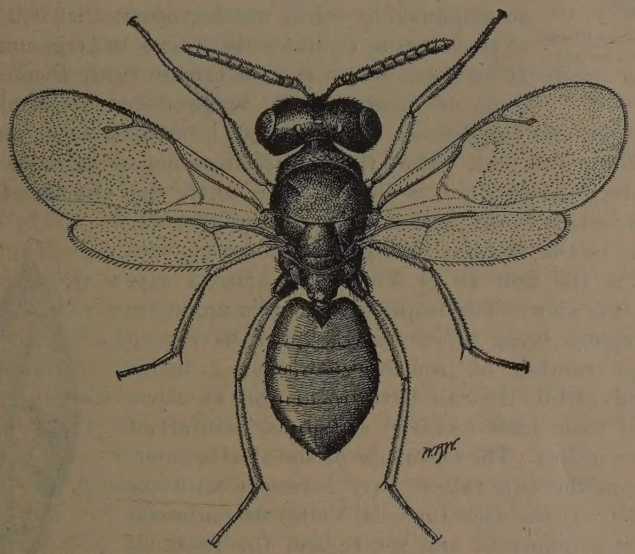

FIG. 8.—*Pteromalus eurymi*, a parasite of the pupa of the alfalfa caterpillar: Adult. Greatly enlarged.

both the caterpillars and pupæ. At times (evidently during periods of high humidity accompanied by warm weather, as in July and August) it becomes so widespread as to kill a great majority of a brood and often nearly annihilates it. This disease is by far the greatest natural check against which the alfalfa caterpillar has to contend. The worms when first attacked take on a lighter green

[1] *Pteromalus eurymi* Gahan. [2] *Chloridea obsoleta* Fab.

color and become sluggish; but in a few hours they change to a brownish black and melt down into a decaying mass.

The dead worms, which are nothing but soft decayed masses found hanging to the alfalfa stalks, are sometimes very numerous. Frequently, where a hay crop is not totally destroyed by a brood of caterpillars before they are killed by this disease, the decayed remains on the hay become so foul as to render the hay quite unpalatable for horses and, hence, of low feeding value.

FIG. 9.—*Pteromalus curymi*: Larva. Greatly enlarged.

As has been suggested, the development of the diseased condition in either larva or pupa depends largely upon moisture. The disease is present at all times, but it is only when a period of high humidity accompanied by warm weather occurs that it becomes so prevalent as to attack the worms in large numbers. It has been found that at certain times these conditions of moisture may be produced artificially by irrigation, and the disease, thus fostered, is utilized as a factor in controlling the pest. That the disease does not at all times keep the caterpillar in check is doubtless due to the dry climate of these Southwestern States, and a comparison of the conditions in the Imperial Valley of California with those in the Salt River Valley of Arizona supports this view. The Imperial Valley is unique in topography, being below sea level, and having an average rainfall of probably less than 2 inches annually, while the Salt River Valley has an elevation of some 1,200 feet and an annual rainfall of about 8 inches. The outbreaks of the alfalfa caterpillar in the two valleys vary inversely with the rainfall. In the drier Imperial Valley the outbreaks are more numerous and severe and the resultant damage is greater than in the Salt River Valley with its greater rainfall and its longer period of humid weather during the hot summer months.

FIG. 10—*Pteromalus curymi*: Adults issuing from chrysalis of alfalfa caterpillar. Enlarged about three diameters.

CONDITIONS AFFECTING INJURY.

This insect is kept in control to a considerable extent by its natural enemies, such as insect parasites and diseases, and it is only upon the occurrence of conditions unfavorable to the development of these enemies that serious outbreaks occur. The seriousness of the damage often depends upon the

farming methods used by the individual whose fields are attacked or upon certain contributory conditions, such as character of soil, quantity of water for irrigation, and location of land. The former cause is one that the individual may remedy by changing his methods, while the latter conditions may be alleviated by proper handling of the particular farm involved.

FIG. 11.—Bollworm (*Chloridea obsoleta*), an enemy of the alfalfa caterpillar. Twice natural size.

The damage in some alfalfa fields apparently is often correlated with the condition of the soil. A field seriously damaged often reveals a poor soil—at least a soil not well adapted to alfalfa culture, and consequently producing a crop that grows but slowly. Of course, not all of the fields damaged are of poor soil; some of the very best alfalfa fields are sometimes seriously ravaged, but in these cases this often is attributable to other factors. Sandy loams or light soils are the best for alfalfa production, and consequently are the least damaged, owing to the fact that alfalfa, growing rapidly, is able to recover from insect attacks and be ready for harvest before any damage has been done. A heavy soil can be improved and the growth of the alfalfa increased by deep plowing and thorough preparation of the seed bed at time of seeding, and afterwards by renovating the alfalfa several times a year, either by disking or by the use of an alfalfa renovator. Such a procedure in irrigated regions will make the soil take water more readily, and thus plant growth will be stimulated.

The progressive grower who uses up-to-date and proper cultural methods is unfortunate indeed when his alfalfa fields are just across the fence from fields that are run down, and, hence, are breeders of insects. No matter how strenuous his efforts, some damage may be done to his crop owing to infestation of his fields from the butterflies supplied by his neighbor's neglected field. Nevertheless enough may be accomplished through his own efforts to repay him many times.

Again, the amount of water applied is often insufficient, sometimes because of neglect on the part of the rancher, and sometimes because of scarcity of supply. The former case is under the rancher's control; he should use care in applying the water and should eliminate waste. Sufficient water should be used to provide for the prompt development of the alfalfa crop, for in this way the grower can harvest his crop before the caterpillars have effected much damage.

THE CONTROL OF THE ALFALFA CATERPILLAR.

DOMESTIC FOWLS.

Both chickens and turkeys feed quite greedily upon the young worms. Where an alfalfa field adjoins a home lot, and chickens have access to the alfalfa field, there are rarely any worms present. When available, a large flock of turkeys, herded by cheap Mexican boy labor in alfalfa before it gets very high, will almost totally reduce an outbreak. Turkeys and chickens are not always available, however, and thus the alfalfa grower must usually adopt other and more generally available methods.

FIG. 12.—Fence row and ditch bank showing neglected growth of alfalfa and grass which offers protection and hibernating quarters for the alfalfa caterpillar and other insect pests.

IRRIGATION AS A FACTOR IN CONTROL.

As has been stated in a previous paragraph, moisture is conducive to the development of the disease which plays an important part in the control of this insect. Therefore, if a rancher can supply water or moisture artificially in a damaged alfalfa field where many larvæ are present, the worms often become diseased. This method is indeed very successful in irrigated regions. If a heavy irrigation is given the field just at the time when the worms are beginning to appear in numbers, this will supply the necessary moisture for the development of the disease and the worms soon will die. In order that a rancher may take advantage of this, it is necessary that he have water available at call, which is not the case in all irrigated regions where water is often distributed in turn. In cases where water can be secured on short notice or when the time for irrigation corresponds

with the occurrence of an outbreak, the water can be utilized and the worms often killed without further trouble.

PASTURING VERSUS HAYING.

Alfalfa fields that are pastured are never troubled as much by the alfalfa caterpillar as are haying fields. This is due partly to the fact that the number of eggs deposited is greatly reduced and also to the fact that many of the eggs and small larvæ are destroyed by the grazing of the stock. The most important factor, however, is that the disease previously mentioned, which is common to many kinds of caterpillars, is more prevalent on pastured ranches than on

FIG. 13.—Fence row bordering alfalfa field, showing clean cutting, which helps to reduce the alfalfa caterpillar as well as other insect pests.

hay ranches. The prevalence of the disease in such fields possibly is due to the fact that usually a few days after stock animals are admitted the alfalfa becomes trampled. The ground and the alfalfa are very moist, there being more or less dew every morning, and droppings from the cattle bring about a foul condition in the field, thus assisting in the retention of moisture, which, in turn, is conducive to the development of the disease.

If fields can be systematically and carefully pastured, damage from the caterpillar will be kept at a minimum. Cattle should never be allowed on a field when wet nor for a longer period than from 24 to 35 days, and disking or renovating should always follow so as to loosen the soil and place it in a receptive condition for future irrigation. Experienced ranchers know the necessity for care in preventing bloating and also know that where labor conditions are properly adjusted the soiling of alfalfa can be carried on more profitably

than pasturing, yet when caterpillars are numerous, these may be destroyed by pasturing.

It is on areas from which successive crops of hay are taken that the height of the damage by the alfalfa caterpillar is reached. In such fields the conditions for the development of the species are as nearly ideal as possible and here the worms are ordinarily unmolested in their feeding and growth. The period elapsing from the time when one crop is cut until another is ready for harvesting so nearly coincides with the length of the period necessary for the development of any one generation of the butterfly that the cutting of the hay, as ordinarily carried on, does not reduce their numbers or disturb their work, since the worm will likely be in the advanced stage, or, perhaps, have passed into the pupal stage before the crop is cut.

CLOSE CUTTING AND CLEAN CUTTING.

In harvesting the hay crop, ranchers usually have to depend upon labor that, while often the best obtainable, is not by any means of the best class, and thus cutting is often done in a careless manner, stubble is left high and ragged, bunches of hay are left uncut at turning rows or on borders, ditch banks and fence rows are rarely or never cut, and the field presents the spectacle shown in figure 12. Any caterpillars that may still be present have thus a considerable amount of alfalfa upon which to feed and develop, so that the butterflies from these are ready for the next crop. Such places also afford bloom which attracts adult butterflies from other fields, and these lay eggs on the new alfalfa that soon springs up. If such neglected fields are treated as is the one shown in figure 13, there will be no food to enable any remaining caterpillars to complete their development; besides this, there will be no protection for them from an early irrigation or the rays of the hot sun, either one of which will kill them. Heat of the midday sun, accompanied by prompt irrigation immediately following such clean cutting, nearly always results in killing the larvæ, especially in the warm Southwest. This is such an important item that one should not hesitate to go to the necessary expense in order to secure such a condition of cleanliness.

VALUE OF DISKING AND RENOVATION.

It has been suggested before that alfalfa fields should be disked or renovated annually or oftener in order to keep the sod in good loose condition, so that it will take water readily and be aerated, and also to kill the weeds. If teams are available or if a tractor can be secured, the best procedure is to renovate several times or at least twice a year. The usual method is to renovate once, and this during the winter. Now, if the alfalfa can be renovated in August, immediately after the third crop is removed, not only will the ground be placed

in an excellent condition and weeds killed, but any larvæ or pupæ on the ground will be killed and future crops protected from damage. Some ranchers are observing this practice, and claim excellent results for it, and a few renovate even oftener. Leaving the matter of insects entirely out of consideration, enough benefit is derived from renovation to pay many times for the cost of the work.

ROLLING AND BRUSH DRAGGING.

At the time a field is being damaged by the worms, the hay that remains undestroyed can be cut and then either a brush drag or a

FIG. 14.—Brush drag used in the destruction of the alfalfa caterpillar in new growing alfalfa.

roller run over the ground, by which a great many of the larvæ may be destroyed.

A good brush drag and one that is well adapted to dragging alfalfa is shown in figure 14. The plan for constructing this, as given by Mr. E. S. G. Titus,[1] is as follows:

> [The drag] is made by laying the butts of rather short brush, 5 or 6 feet long, in a row on a plank 12 or 14 feet long, then another row should be laid upon the first, consisting of longer brush, with the butts trimmed a little further back so that you will have in effect two brush harrows, one following the other. Another plank should then be laid on the brush butts and bolted to the under plank. In weighting this harrow, lay an ordinary tooth harrow, with the teeth down, directly on the brush drag. This makes a very even weight, at the same time it is so flexible that the drag will work its way down into the small depressions as well as over the larger elevation of the field.

[1] Titus, E. G. The alfalfa leaf-weevil. Utah Agr. Coll. Exp. Sta. Bul. 110. 1910.

SUMMARY OF CONTROL MEASURES.

Keep the ranch in the best possible cultural condition. Irrigate it often and thoroughly, either immediately before cutting or as soon after cutting as the crop of hay can be removed from the ground.

Renovate every winter and during the month of August, or even oftener if possible, by the use of a good type of alfalfa renovator, thus disturbing any pupæ that may be present and putting the land and alfalfa in condition for good growth of succeeding crops.

Cut the alfalfa close to the ground and clean, especially along the ditch banks, borders, and turning rows, as well as in the main part of the field.

Cut the alfalfa earlier than is the general rule. The proper time is when it is just coming in bloom or is one-tenth in bloom. Watch for caterpillars in the early spring crop, and if many are observed and are about grown, cut the hay a few days before it is in bloom, and thus save the next and future crops.

A minimum amount of damage occurs in fields that are systematically pastured all or a part of the time.

Excessive moisture is conducive to a diseased condition of the larvæ, and this one fact is of the greatest importance in control. When worms begin to appear in numbers, if possible supply this moisture by irrigation and thus assist nature to destroy the worms.

A field should never be abandoned because the caterpillars threaten the destruction of a crop of alfalfa before the hay can possibly mature. Mow it at once, cutting it low and clean, thus saving part of the present crop, and in so doing starve this generation of worms and allow the heat of the sun to kill a great many. Follow this by disking and then by either rolling or brush dragging, and a great majority of any remaining larvæ will be killed. The ground should then be thoroughly irrigated, and by these efforts the future crop will be assured.

Turkeys and chickens when allowed the run of a field will keep the numbers of the caterpillars at a minimum.

The protection of toads should be encouraged, as they eat many of these insects as well as other injurious forms.

It has been noted that carrying out only a part of these recommendations will not at all times save the crop. The best results come when one is thorough in his methods.

Cooperation among all growers is necessary to suppress completely an insect attack. An occasional outbreak has been known to occur upon a farm or ranch that is under the best possible condition of crop culture, but in each case it was noted that the careless methods of a neighbor were responsible for the infestation.

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